(12) UK Patent Application (19) GB (11) 2 344 253 (13) A

(43) Date of A Publication 31.05.2000

(21) Application No 9923196.1

(22) Date of Filing 01.10.1999

(30) Priority Data
(31) 9821265 (32) 01.10.1998 (33) GB

(51) INT CL[7]
H04M 11/00

(52) UK CL (Edition R)
H4K KOC
H4P PPEC

(56) Documents Cited
GB 2305818 A WO 97/47126 A1 WO 97/26750 A1
US 4833618 A

(58) Field of Search
UK CL (Edition R) H4K KOC, H4P PEUL PEUX PPEC PQA
INT CL[7] H04M 11/00
Online Databases: WPI, EPODOC, JAPIO

(71) Applicant(s)
Robert John Wilson
5 Strandview Cottages, Castlerock, COLERAINE, BT51 4XS, United Kingdom

Terence John McCavana
54 Seacliff Road, BANGOR, County Down, BT20 5EZ, United Kingdom

David Campbell Morrison
47 Ormonde Park, BELFAST, BT10 0LT, United Kingdom

(72) Inventor(s)
Robert John Wilson
Terence John McCavana
David Campbell Morrison

(74) Agent and/or Address for Service
Murgitroyd & Company
373 Scotland Street, GLASGOW, G5 8QA, United Kingdom

(54) Abstract Title

Remote control and monitoring of devices over the Internet using electronic mail

(57) Data from a device 1 capable of originating and receiving data is sent to a discrete hardware and embedded software unit 2 comprising a hardware interface 4, a microprocessor logic chip 5 and modem 6. The unit 2 encodes the data and transmits it by electronic mail via the Internet to a remote computer 3 for further processing and logging. Alternatively the data is transmitted via an Intranet, PSTN or radio network. Control data may also be transmitted to the device. The device may be a gas or electricity meter which is remotely read. Security means includes a watchdog timer for resetting the microprocessor logic chip and means to stop transmission in the event of a predetermined number of transmission errors.

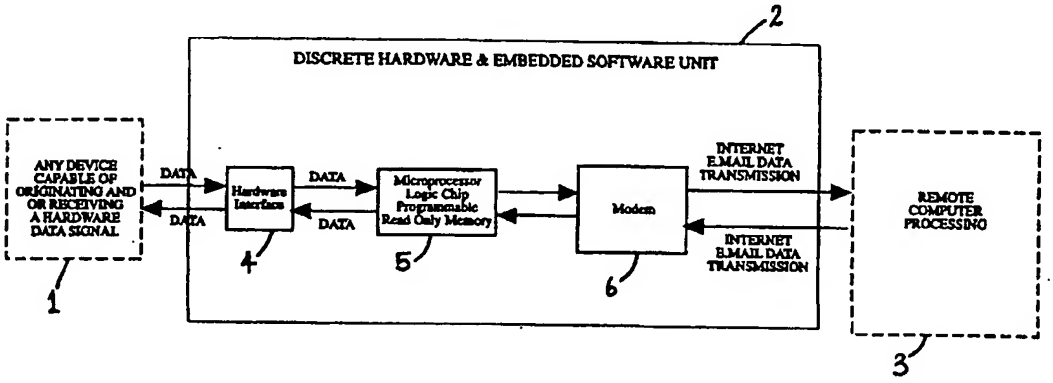


Fig. 1

GB 2 344 253 A

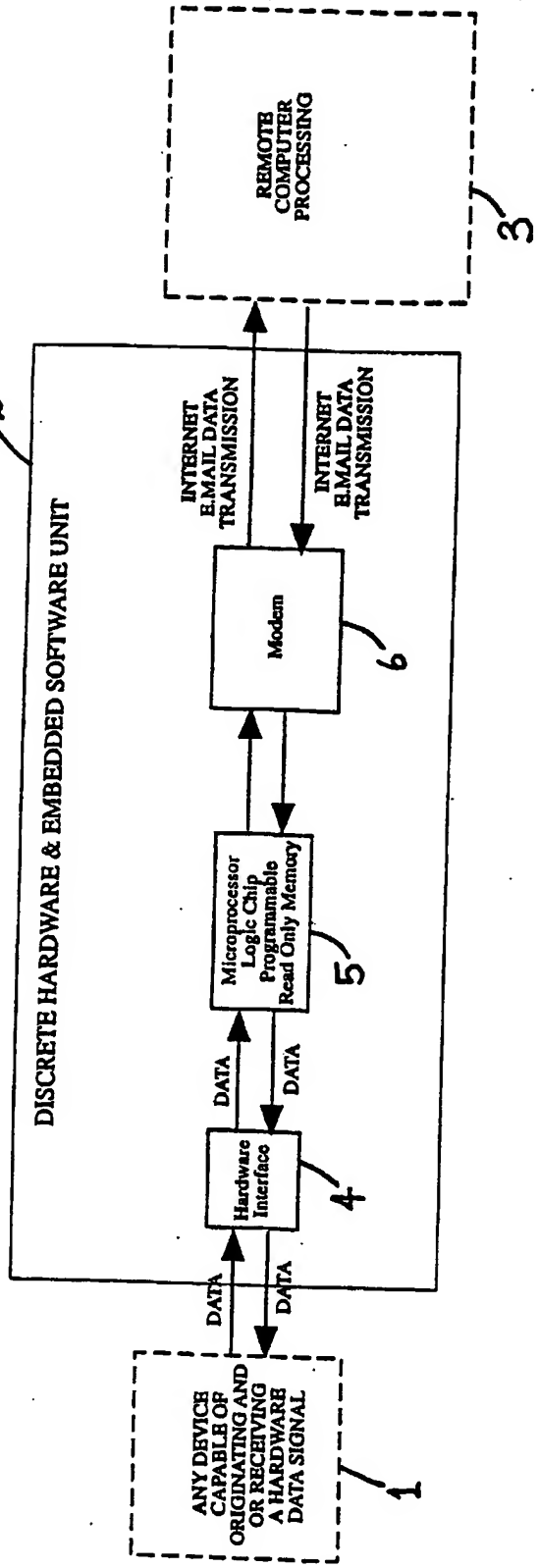

REMOTE COMPUTER PROCESSING
3
2
DISCRETE HARDWARE & EMBEDDED SOFTWARE UNIT
INTERNET E.MAIL DATA TRANSMISSION
INTERNET E.MAIL DATA TRANSMISSION
Modem
6
Microprocessor Logic Chip Programmable Read Only Memory
5
DATA
DATA
Hardware Interface
4
DATA
DATA
ANY DEVICE CAPABLE OF ORIGINATING AND OR RECEIVING A HARDWARE DATA SIGNAL
1

Fig. 1

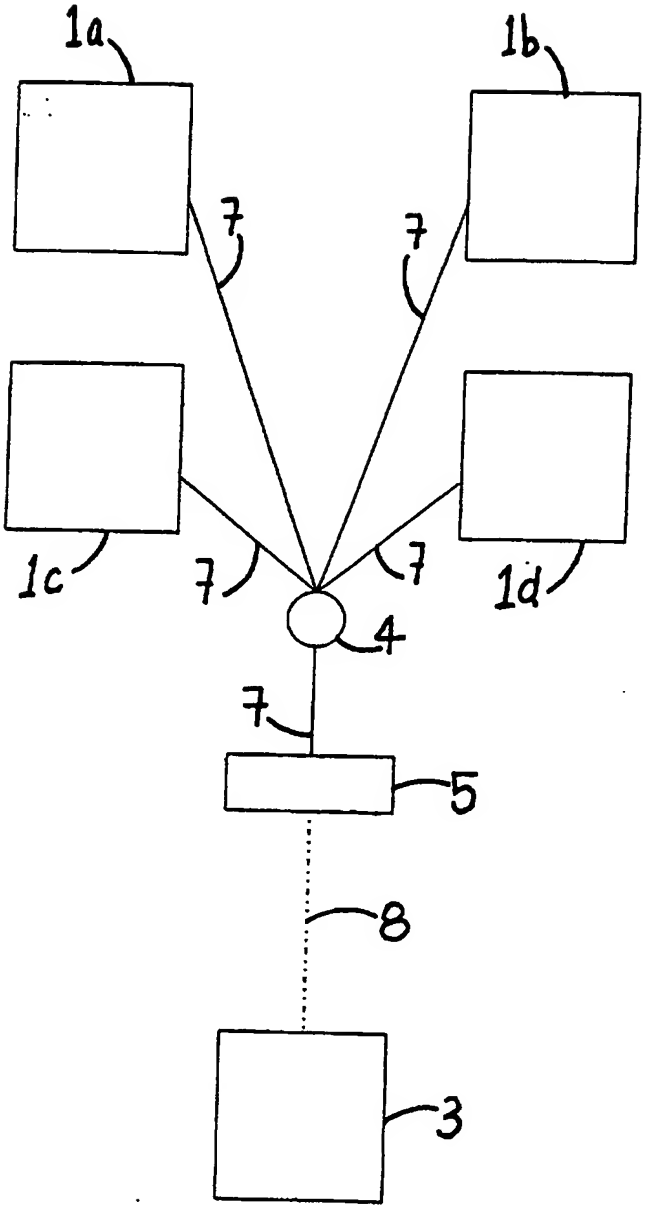


Fig. 2

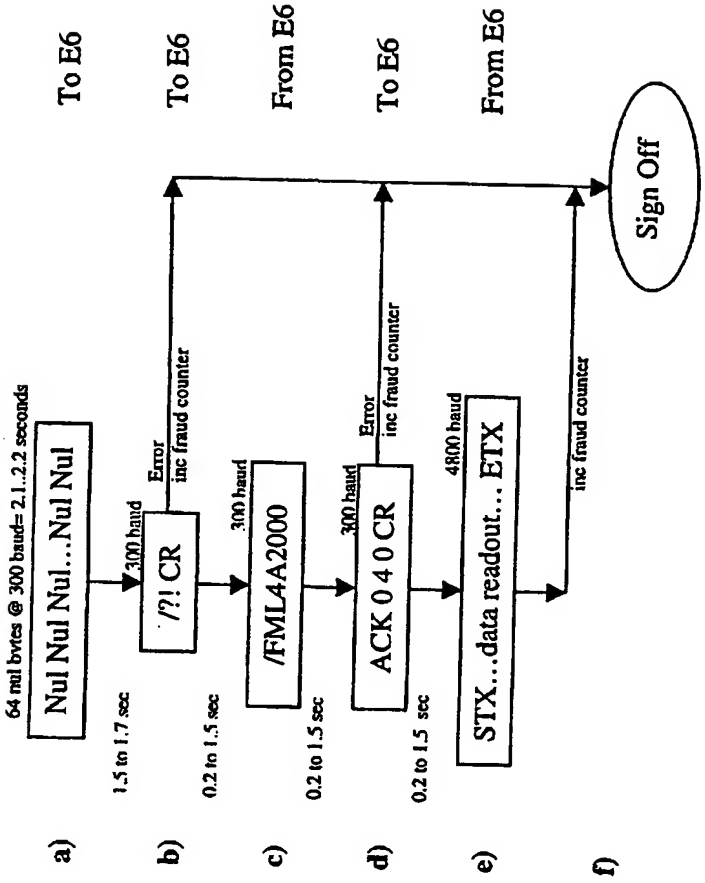
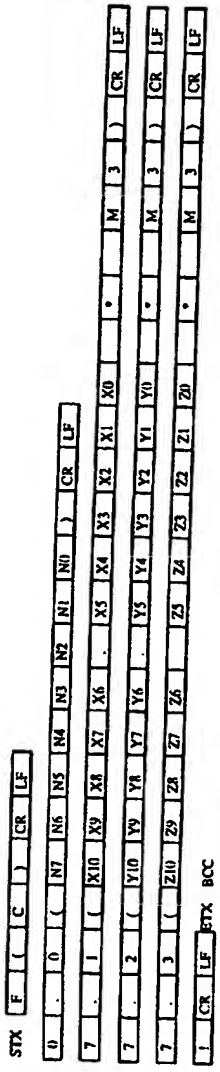

64 nul bytes @ 300 baud= 2.1..2.2 seconds
Nul Nul Nul...Nul Nul
To E6
a)
1.5 to 1.7 sec
300 baud
/?! CR
Error
inc fraud counter
To E6
b)
0.2 to 1.5 sec
300 baud
/FML4A2000
From E6
c)
0.2 to 1.5 sec
300 baud
ACK 0 4 0 CR
Error
inc fraud counter
To E6
d)
0.2 to 1.5 sec
4800 baud
STX...data readout... ETX
From E6
e)
inc fraud counter
Sign Off
f)

Fig. 3



Empty format of data readout string:

Fig. 4

"Data Transmission System"

The present invention relates to a data transmission system, and in particular to a data transmission system which establishes a two way communication between a remote computer processor and a device, machine or apparatus; the two way communication taking place at least in part by an electronic mail message via a computer network such as the Internet to provide remote control and monitoring functionality to embedded systems.

According to a first aspect of the present invention, there is provided a data transmission system having a hardware interface for sending and receiving data to/from a data producing device; a data encoder which receives and sends data from/to the hardware interface; a network communicator, for receiving and sending encoded data from/to the data encoder and also for receiving and sending data from/to a remote computer for processing.

Preferably, the data encoder is a Microprocessor Logic Chip.

Preferably, the network communicator is a modem.

Preferably, the data encoder receives and sends data from/to the remote computer via a computer network such as the Internet or Intranet.

In use, the data is sent either automatically or on the request of the remote computer.

According to a second aspect of the present invention, there is provided a method of transmitting data comprising the steps of: collecting data from a data producing device; sending said data to a data encoder via a hardware interface; sending said encoded data to a network communicator which sends said encoded data to a remote computer for processing.

Preferably, the data encoder is a Microprocessor Logic Chip and the network communicator is a modem.

Preferably, the data encoder receives and sends data from/to the remote computer via a computer network such as the Internet or Intranet.

Preferably, the data transmitted between the network communicator and the remote computer is in the form of electronic mail.

Preferably, the data can also flow in the opposite direction thus enabling the remote computer to communicate with the data producing device.

Preferably, there is provided security means for inhibiting the system in the event of a predetermined number of consecutive error signals.

The Microprocessor Logic Chip may be a programmable Read Only Memory (ROM). In use, the Microprocessor Logic Chip may be a chip set.

The network communicator may connect to the computer network by means of a standard PSTN connection or dedicated line, by radio signal, mobile telephony or by optical fibre.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic block diagram of the system of the present invention;

Fig. 2 is a schematic block diagram of one application of the present invention;

Fig. 3 is a flow diagram showing the communication between a meter and an optical communications protocol, in another application of the present invention; and

Fig. 4 is an example of a readout string from the meter of Fig. 3.

Referring to Fig.1, there is illustrated a device 1 capable of originating data to be sent to a discrete hardware and embedded software unit 2 which provides the means for electronically mailing data from the device 1 to a remote computer 3 either automatically or on the request of the remote computer 3. This data is sent initially to a hardware interface 4 which provides a data bridge between the device 1 and a Microprocessor Logic Chip 5.

The Microprocessor Logic Chip 5 processes the data received from the hardware interface 4 and communicates the processed data through a modem 6 by electronic mail via the Internet in a conventional manner to the remote computer 3 for further processing and logging. The modem being suitable for connection to PSTN (Public Switched Telephone Network) with a transfer rate of at least 2400 baud.

The modem 6 is of modular construction.

The remote computer 3 can also communicate with the device 1 by electronically mailing, via the Internet in the conventional manner, data which is then picked up by the Microprocessor Logic Chip 5 via the modem 6 connection to the Internet. The Microprocessor Logic Chip 5 then processes the electronic mail data and transmits it to the hardware interface 4 which in turn communicates this data to the device 1. The device 1 then responds in a pre-programmed way to the data which it receives.

By way of illustration, the system will now be described as applied to an electricity meter. Referring to Fig.2, there is illustrated four electricity meter devices 1a to 1d. The devices 1a to 1d are capable of generating data regarding the amount of electricity used (for example, a data string 1,105 would represent meter 1 and a meter reading of 105 units). Each of the meters 1a to 1d produces this data stream automatically and transmits the data by a suitable means 7 (for example, by a fixed line or by radio transmission) to a hardware interface 4 which processes this data and communicates it by a suitable means 7 to a processor 5 which contains a Microprocessor Logic Chip and a modem. The

Microprocessor Logic Chip processes the data for sending by electronic mail via the Internet 8 to a remote computer 3. The remote computer 3 can then process and log the meter readings of each device 1a to 1d.

The remote computer 3 can also communicate with each device 1a to 1d by sending data by electronic mail via the Internet 8 to the processor 5 which can then communicate the data to each device 1a to 1d by way of the hardware interface 4. This is useful, for example, if the supplier of the electricity wishes to suspend their supply. The action that each device 1a to 1d takes is dependent on their pre-programming.

Electricity meters, especially older models generally operate on a rotating disk principle, where the number of rotations of the disk is proportional to the amount of electricity being consumed. These types of meters can be modified to generate a pulse train, the frequency of which is proportional to the amount of energy being consumed.

The system is also provided with security means which comprises a watchdog timer which needs to be regularly triggered by the application code of the software. After five seconds the watchdog timer will expire and the Microprocessor Logic Chip 5 will automatically reset. The watchdog timer can be disabled during development work on the system.

The system is also provided with a power down function which reduces power consumption by powering down parts of the electronics which consume excessive power. This is achieved by power switching during periods of inactivity.

An input pulse counter is also provided for counting rising or falling transitions of an external input signal.

The software used to drive the hardware described comprises an initialisation routine, device drivers and system modules. The software is written on conventional software development programs.

The initialisation routine is activated by the hardware power-up trigger and automatically executes the startup code as well as also disabling interrupts and initialising the serial driver and the pulse count driver.

The serial driver sends and receives messages over a single serial interface.

An error recovery module is provided which places an appropriate message in a message log when exception or status information is reported.

The system is capable of operation over the standard commercial temperature range (0 to 70 deg C).

At a predetermined time, a process input module arranges for the meter to be read by sending and receiving messages via the serial driver to the meter.

The meter reading is formatted and sent to a create email module.

The meter reading is inserted into an email message template and the email is sent.

By way of further illustration of a specific

application of the invention, the system will now be described as applied to a gas meter and the optical communication protocol used in the gas meter to allow interrogation of basic metrology data via the IEC 1107 optical communications protocol.

The data format is 1 start bit, 7 data bits, 1 parity bit, 1 stop bit, even parity. Information is transmitted as 7 bit ASCII, including numeric data.

The procedure to establish optical communication with the meter and obtain volume data is described here using the fixed 300 baud and normal 4800 baud rates. Steps a) to f) below are shown in the flow diagram of Fig. 3.

a) Because the meter is battery powered, optical communication has to be enabled when required, to conserve energy. This is achieved by transmitting a "Null string" to the meter which is 2.1 seconds in duration and sent at 300 baud.

b) Next an identification request is transmitted to the meter "/?!CRLF" (at 300 baud). This corresponds to an ASCII string 2F3F210D0A. If the message received by the meter is not "/?!CRLF" the meter increments its fraud counter and stops the communication session.

c) The meter should respond with an identification string. The content will depend on the meter model, but is generally of the form "/FML4" followed by 12 more ASCII characters. This string is transmitted at 300 baud. Typical identification strings are-

"/FML4BGas Ser IAA"

"/FML4A2000 Ser 2"

The identification strings are used for more complex communications to assist set-up of the session. For data readout, the identification string content is superfluous. A check that the first character received from the meter is "/" is sufficient.

d) The module must then request the data readout message by sending the following string-

"Ack 0 4 0 CR LF" in ASCII 063034300D0A

The character "4" is an indicator of the baud rate at which the data readout message is expected. The default set-up of the Gas Meter is 4800 baud - "4". Alternatives are-

Char	baud
0	300
1	600
2	1200
3	2400
4	4800
5	9600

If the baud rate character sent to the meter does not match the baud character sent from the meter in its identification string "/FML4A2000 Ser 2" the meter will increment its fraud counter and terminate the communication session. The meter will also record the baud character sent to it in the "Ack 0 x 0 CR LF" message and will use this next time the identification message is transmitted from the meter.

If the selected hi-speed rate is 300 baud, there is not enough time to send the Data Readout String, so the meter replies with an "empty"

string, 7 characters long.

e) Within 0.2 to 1.5 seconds the meter will respond with a data readout string at the baud rate specified in the acknowledge/request for readout string just sent to the meter.

f) After the readout string has been transmitted, the meter shuts down the optical communication ie "signs off". If the readout string is required again, the communication process must be repeated from the wakeup null string.

To prevent excessive power drain of the battery by repeated data readout requests, each time a request is received, a communication error (fraud counter) is incremented. If the counter value exceeds 3, the meter "locks out" optical communication until the next hour change of the real time clock in the meter. If more than 3 further data readout requests are received, the meter locks out optical communication until 24.00. At 24.00 the communication fraud counter is reset to 0 and optical communication is allowed. It is not possible to request the data readout string more than 6 times in a 24 hour period.

The Data Readout string from the meter is an output giving the meter volume, temperature compensated volume and negative volume, and a fault flag code, it is sent in response to the sign-on acknowledge string ACK 0 X 0 CR LF, (X is the baud select digit, 4=4800 baud).

Normal Format of Readout String is shown in Fig. 4 wherein:

C Fault flag ASCII code of

A,b,C,d,E,F,H,L,n,P,r,t,U, or 0 (zero) if no fault

N 7..0 Serial number of gas meter, 8 digit ASCII coded decimal N0 is the least significant digit

X 10..0 Meter volume, 11 digit ASCII coded decimal X0 is the least significant digit. A full stop character separates digit 6 and 5

Y 10..0 Temperature corrected volume, 11 digit ASCII coded decimal Y0 is the least significant digit. A full stop character separates digit 6 and 5.

Z 10..0 Reverse volume, 11 digit ASCII coded decimal Z0 is the least significant digit. A full stop character separates digit 6 and 5.

The three meter index values X, Y, Z are in cubic meters, the full stop character represents the decimal point of each value.

Module communication software provided should be able to respond to communication failures, detect communication lock-outs and be able to switch between the initial 300 baud rate and the 4800 hi-speed baud rate.

If a message other than the identification request "/?!CRLF" is sent after the null byte wake up string the meter will increment its fraud counter and terminate the communication session.

If there is no response from the meter to the request

"/?!CRLF" message then the meter has accumulated sufficient fraud or failed attempts to shut down serial communication until either the next hour change or the next day change of the gas meter real time clock.

Communication is started at 300 baud, the meter will normally switch to 4800 baud after this point. For the remaining data readout communication to occur, the module should have sent a "4" in its acknowledge message. If the module sends a different character, the meter will respond with a NAK (Negative Acknowledgement) character, terminate the communication session (sign off) and increment the fraud counter. It will record the baudrate character and use this to compare with the next baudrate character it receives in the next sign-on attempt. When they match, communication continues at that baudrate.

This feature allows a module to set-up the meter to respond at a different hi-speed baud rate than the factory configured 4800 baud. Once it has been changed by the 2 pass sign on process described above, future sign ons will normally succeed first time.

The highest level of active fault code in the meter is shown as a single ASCII character in the position described in section 4. Data Readout String Definition. The letter correspond to the fault code letter shown on meter display. If no faults are detected, the data readout string will substitute 0 (number zero, ASCII 30 hex), and the meter fault display character will be blank.

The fault code letters that can be displayed and included in the data readout string are:
A,b,C,d,E,F,H,Ln,P,r,t,U, or 0 (Zero) if no fault

Letter A is the most significant fault level, U is the least significant fault level.

Whilst the above illustrates the use of the present invention in relation to electricity meters and describes by way of specific example the application to a gas meter. The present invention can also be applied to water meters, tachographs, temperature sensors, pressure sensors, meteorological measurement systems, magnetic swipe cards, movement detectors, Ph meters, clock card systems, computers, ammeters, volt meters, resistance meters, time measurement systems, distance measurement systems, cameras, video cameras, chemical analysis systems, radio systems, flow meters, weighing machines, bar code readers, counting systems, velocity measurement systems, depth measurement systems, echo sounders, compass systems, optical systems, sound measurement systems, tensile measurement systems, gas, smoke, and fire detectors, wetness systems, rotational measurement systems, magnetometers, photocopiers and traffic speed cameras for example.

The electronic mail message may also be transmitted via an Intranet network.

Modifications and improvements may be made to the foregoing within the scope of the present invention.

CLAIMS

1. A data transmission system having a hardware interface for sending and receiving data to/from a data producing device; a data encoder which receives and sends data from/to the hardware interface; a network communicator, for receiving and sending encoded data from/to the data encoder and also for receiving and sending data from/to a remote computer for processing.

2. A data transmission system according to Claim 1, wherein the data encoder is a Microprocessor Logic Chip.

3. A data transmission system according to either preceding claim, wherein the network communicator is a modem.

4. A data transmission system according to any preceding claim, wherein the data encoder receives and sends data from/to the remote computer via a computer network such as the Internet or Intranet.

5. A data transmission system according to any preceding claim, whereby in use the data is sent either automatically or on the request of the remote computer.

6. A data transmission system according to any preceding claim, wherein there is provided security means for inhibiting the system in the event of a predetermined number of consecutive error signals.

7. A data transmission system according to Claim 2,

wherein the Microprocessor Logic Chip may be a programmable Read Only Memory (ROM). In use, the Microprocessor Logic Chip may be a chip set.

8. A data transmission system according to any preceding claim, wherein the network communicator may connect to the computer network by means of a standard PSTN connection or dedicated line, by radio signal, mobile telephony or by optical fibre.

9. A data transmission system according to any preceding claim, wherein the data is derived from an electricity meter, the data being representative of the electricity measured by the meter.

10. A data transmission system according to any of Claims 1 to 8, wherein the data is derived from a gas meter, the data being representative of the gas measured by the meter.

11. A method of transmitting data comprising the steps of: collecting data from a data producing device; sending said data to a data encoder via a hardware interface; sending said encoded data to a network communicator which sends said encoded data to a remote computer for processing.

12. A method of transmitting data according to Claim 11, wherein the data encoder is a Microprocessor Logic Chip and the network communicator is a modem.

13. A method of transmitting data according to either of Claims 11 or 12, whereby the data encoder

receives and sends data from/to the remote computer via a computer network such as the Internet or Intranet.

14. A method of transmitting data according any of Claims 11 to 13, whereby the data transmitted between the network communicator and the remote computer is in the form of electronic mail.

15. A method of transmitting data according any of Claims 11 to 14, whereby the data can also flow in the opposite direction thus enabling the remote computer to communicate with the data producing device.

16. A method of transmitting data according to any of Claims 11 to 15, whereby the data is derived from an electricity meter, the data being representative of the electricity measured by the meter.

17. A method of transmitting data according to any of Claims 11 to 15, whereby the data is derived from a gas meter, the data being representative of the gas measured by the meter.

18. A data transmission system substantially as hereinbefore described with reference to or as shown in the accompanying drawings.

19. A method of transmitting data substantially as hereinbefore described with reference to or as shown in the accompanying drawings.

The Patent Office

INVESTOR IN PEOPLE

16

Application No:	GB 9923196.1	**Examiner:**	Gareth Griffiths
Claims searched:	All	**Date of search:**	15 March 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H4K (KOC), H4P (PEUL, PEUX, PPEC, PQA)

Int Cl (Ed.7): H04M 11/00

Other: Online Databases: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB2305818 A	(RICOH) p.14 line 15 - p.19 line 22	1-17
X	WO97/47126 A1	(ET COMMUNICATIONS) FIG.1 & p.9 line 20 - p.11 line 7	1-12, 15-17
X	WO97/26750 A1	(CELLPORT) figs 1 & 2	1-8, 10-12, 15-17
X	US4833618	(VERMA) whole document	1-12, 15-17

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.